

Atty. Dkt. 160-400  
YA-03S1067

# ***U.S. PATENT APPLICATION***

***Inventor(s):*** Teruaki ITOH

***Invention:*** AUTOMATIC TUBE-TYPE SPECIMEN CONTAINER SUPPLY  
APPARATUS

***NIXON & VANDERHYE P.C.  
ATTORNEYS AT LAW  
1100 NORTH GLEBE ROAD, 8<sup>TH</sup> FLOOR  
ARLINGTON, VIRGINIA 22201-4714  
(703) 816-4000  
Facsimile (703) 816-4100***

## ***SPECIFICATION***

TITLE OF THE INVENTION

AUTOMATIC TUBE-TYPE SPECIMEN CONTAINER SUPPLY APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

5 This application is based upon and claims the  
benefit of priority from the prior Japanese Patent  
Application No. 2002-349951, filed December 2, 2002,  
the entire contents of which are incorporated herein by  
reference.

BACKGROUND OF THE INVENTION

10 1. Field of the Invention

The present invention relates to an automatic  
tube-type specimen container supply apparatus for  
automatically supplying tube-type specimen containers  
that are used to dispense a large number of specimens  
15 such as blood and urine.

2. Description of the Related Art

In order to dispense a large number of specimens  
such as blood and urine, a large number of tube-type  
specimen containers are required as slave specimen  
20 containers. If a user purchases tube-type specimen  
containers that are held in a rack, his or her running  
costs will increase. If a user purchases tube-type  
specimen containers that are not held in a rack, he or  
she needs to expend much effort to hold the specimen  
25 containers in a rack though the unit price of the  
specimen containers reduces. As one measure against  
this, a specimen container supply apparatus using

a parts feeder has been in practical use. However, this apparatus is so noisy that it makes work environment much worse.

Jpn. Pat. Appln. KOKAI Publication No. 07-213586  
5 discloses an automatic specimen container supply apparatus. This apparatus is capable of removing specimen containers (test tubes), which are arranged in a hopper, one by one using a rotary drum. The rotary drum is located at the bottom of the hopper and  
10 provided with a groove for removing the specimen containers.

The apparatus disclosed in the above Publication is a breakthrough in that it can remove specimen containers one by one. However, the apparatus cannot  
15 remove any specimen containers that are randomly inserted in the hopper. The specimen containers are removed downward through an outlet formed in the lower part of the hopper by the rotary drum. If, therefore, a large number of specimen containers concentrate in  
20 the outlet, the outlet is likely to be clogged by the weight of the specimen containers themselves.

#### BRIEF SUMMARY OF THE INVENTION

An object of the present invention is to provide an automatic tube-type specimen container supply  
25 apparatus having the following advantages.

1) The randomly inserted specimen containers can be removed one by one and supplied to a position for

use.

2) There is no fear that the outlet will be clogged with the specimen containers.

5 In order to attain the above object, an automatic tube-type specimen container supply apparatus according to the present invention has the following characteristic configuration. The other characteristic configurations will be clarified in the embodiment.

10 An automatic tube-type specimen container supply apparatus according to an embodiment of the present invention, comprises a container storing box a bottom of which has a tapered surface having a container collecting position in a lowest part thereof to collect a plurality of tube-type specimen containers  
15 in one spot through an insertion port, a container individually-sending mechanism configured to lift up the specimen containers, which are collected in the container collecting position, one by one along one side wall located close to the container collecting  
20 position, an outlet formed in the one side wall to discharge the specimen containers, which are lifted up by the container individually-sending mechanism, outside the container storing box, and a container carry-out mechanism including a carry-out conveyor  
25 to automatically carry out the specimen containers discharged through the outlet,

wherein the container individually-sending

mechanism includes a drive source and a lifting plate which is driven up and down by the drive source, and the lifting plate has a top end with a tapered surface, the tapered surface having a space to place only one specimen container lying on a side thereof and descending toward an outside of the container storing box.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

FIG. 1 is a schematic sectional view of the side of the container-storing box (when a lifting plate is lowered), illustrating the entire configuration and operation of the automatic tube-type specimen container supply apparatus according to the embodiment of the present invention.

FIG. 2 is a schematic sectional view of the side of the container-storing box (when the lifting plate is raised), illustrating the entire configuration and operation of the automatic tube-type specimen container supply apparatus according to the embodiment of the present invention.

FIG. 3 is a perspective view showing an outward appearance of the automatic tube-type specimen container supply apparatus according to the embodiment of the present invention.

FIG. 4 is an exploded perspective view of a movable section of the automatic tube-type specimen container supply apparatus according to the embodiment

of the present invention.

FIG. 5A is a partly cutaway side view of a movable section of a container individually-sending mechanism (when the lifting plate is lowered) of the automatic tube-type specimen container supply apparatus according to the embodiment of the present invention.

FIG. 5B is a partly cutaway side view of a movable section of a container individually-sending mechanism (when the lifting plate is raised) of the automatic tube-type specimen container supply apparatus according to the embodiment of the present invention.

#### DETAILED DESCRIPTION OF THE INVENTION

(Embodiment)

FIGS. 1 and 2 illustrate a container storing box 10 having an insertion port 10a on its top end. The bottom of the box 10 has a tapered surface in order to collect a plurality of resin or glass-made tube-type specimen containers 1 that are randomly inserted through the insertion port 10a. A container collecting position 14 is located in the lowermost part of the tapered surface.

The bottom of the box 10 has a two-layer structure including a first partition plate 11 and a second partition plate 12 that are vertically opposed to each other. The first partition plate 11 has a tapered surface that descends gently from one side to the other side. The second partition plate 12 has a tapered

surface that descends gently in the direction opposite to the tapered surface of the first partition plate 11. The upper layer of the box 10 is formed of room A and the lower layer thereof is formed of room B.

5 A relatively narrow path 13 is formed between the first and second partition plates 11 and 12 to allow the specimen containers to pass therethrough one by one while lying on their sides.

10 A container individually-sending mechanism 20 is so provided that it can push up specimen containers 1, which are collected in the container collecting position 14, one by one along one side wall 15 located close to the position 14.

Referring to FIGS. 3 and 4, the container  
15 individually-sending mechanism 20 includes a fixing section 20A and a movable section 20B. The fixing section 20A has a pair of plate guide blocks 26a and 26b and a pair of plate guide walls 27a and 27b on the inner surface of the sidewall 15. The plate guide  
20 blocks 26a and 26b are arranged in parallel at a fixed interval therebetween, as are the plate guide walls 27a and 27b. The sidewall 15 has an outlet 31 (described later) on its top. A guide plate 32a (described later) is attached to a region above the outlet 31.

25 The movable section 20B includes a U-shaped mounting base 24. The mounting base 24 has a pair of mounting pieces 24a and 24b at both ends. The mounting

pieces 24a and 24b are combined with their respective plate guide blocks 26a and 26b of the fixing section 20A. Thus, the fixing section 20A and movable section 20B are formed integrally as one component.

5           A drive source 23, which is formed of, e.g., an air piston device, is mounted on the underside of the mounting base 24. A drive shaft 23a of the drive source, which penetrates the mounting base 24, is coupled to the bottom end of a lifting plate 21. Thus,  
10           the lifting plate 21 can be reciprocated up and down by the drive source 23.

          The lifting plate 21 is formed of a plate-like element and its top end has a tapered surface T1 as illustrated in FIGS. 5A and 5B. The tapered surface T1  
15           has a long, narrow space in which only one specimen container 1 can be placed lying on its side. The tapered surface T1 descends toward the outside of the container storing box 10.

          An auxiliary plate 22 is mounted on one side  
20           (left side in FIGS. 5A and 5B) of the lifting plate 21. The auxiliary plate 22 can slide up and down relative to the lifting plate 21. More specifically, pins 21a and 21b are implanted into the lifting plate 21 and long slits 22a and 22b are formed in the auxiliary  
25           plate 22. The pins 21a and 21b are fitted into the slits 22a and 22b, respectively. Like the top end of the lifting plate 21, the top end of the auxiliary



plate 22 has a tapered surface T2 that descends toward the outside of the container storing box 10. When the auxiliary plate 22 descends to a given level, its bottom end contacts a stopper 25 on the mounting base 24, with the result that the auxiliary plate 22 is prevented from descending beyond the level.

When the lifting plate 21 descends, the top end of the lifting plate 21 and that of the auxiliary plate 22 are flush with each other (the tapered surfaces T1 and T2 are flush with each other) as shown in FIG. 5A. When the lifting plate 21 ascends, the top end of the auxiliary plate 22 is located at a lower level than that of the lifting plate 21 as shown in FIG. 5B.

Referring back to FIGS. 1 and 2, a container carry-out mechanism 30 has an outlet 31 on its one sidewall 15, as described above. The outlet 31 is used to discharge the specimen containers 1, which are lifted up by the container individually-sending mechanism 20, outside the container-storing box 10. A specimen container-discharging guide section 32 is coupled to the outlet 31. The guide section 32 includes a guide plate 32a provided at a section coupled to the outlet 31 and a guide path 32b that communicates with the guide plate 32a and guides the specimen containers 1 to a carry-out conveyor 33. The carry-out conveyor 33 is made of, e.g., rubber and automatically carries the specimen containers 1 outside

the box from the guide section 32.

An operation of the automatic tube-type specimen container supply apparatus so configured will now be described. Tube-type specimen containers (e.g., slave specimen containers) 1 to be supplied automatically are randomly inserted into the room A through the insertion port 10a by hand. Some of the inserted specimen containers 1 enter the room B from the room A through the path 13 formed in the boundary between the rooms A and B. Then, the specimen containers are collected in the container collecting position 14 that is the lowest position of the container storing box 10. Of the specimen containers 1 collected in the position 14, the specimen containers placed on the tapered surface T1 of the top end of the lifting plate 21 of the mechanism 20 are lifted up to the level of the outlet 31 as the plate 21 rises.

When a specimen container 1 is lifted up in an upright position, its top end contacts the bottom end of the guide plate 32a that is inclined. The center of gravity of the specimen container 1 is therefore inclined toward the inside of the box 10. Consequently, the specimen container 1 drops again toward the bottom of the box 10. Only one specimen container 1 is placed on the top end of the lifting plate 21. Thus, only one specimen container 1, which is lifted up lying on its side, is discharged outside

the box through the outlet 31. The discharged specimen container 1 reaches the carry-out conveyor 33 through the guide path 32b. The specimen containers 1 that have reached the carry-out conveyor 33 are automatically carried one by one outside the box 10 by the carry-out conveyor 33. The above carry-out operation is performed each time the lifting plate 21 moves up and down.

When the carry-out operation continues, the specimen containers 1 are moved away from the periphery of the lifting plate 21. Thus, the specimen containers 1 cannot be lifted up even though the lifting plate 21 repeats its lifting operation again and again.

The above drawback does not occur because the lifting plate 21 is provided with the auxiliary plate 22. More specifically, when the lifting plate 21 descends, the bottom end of the auxiliary plate 22 is supported by the top end of the stopper 25. The top end of the auxiliary plate 22 thus becomes flush with that of the lifting plate 21. The slave specimen container 1 slides on the above tapered surface and is smoothly placed on the top end of the lifting plate 21. When the lifting plate 21 ascends, the top end of the auxiliary plate 22 is located at a lower level than that of the lifting plate 21. In other words, the flush-surface state that is obtained when the lifting plate 21 descends is released to thereby form a step

between the top ends of the lifting plate 21 and auxiliary plate 22. By performing this operation, the wall of a block of specimen containers 1 to be formed around the plates 21 and 22 is crumbled.

5           When the lifting plate 21 descends again, the specimen containers 1 smoothly slide on the tapered surface from the top end of the auxiliary plate 22 to that of the lifting plate 21. Thus, one or more specimen containers 1 are always placed on the lifting  
10       plate 21 that has descended. The operation for sending out the specimen containers 1 is performed without fail.

          As a result of the repetition of the above operation, the foregoing drawback does not occur and  
15       the specimen containers are reliably lifted up whenever the lifting plate 21 ascends. In the above embodiment, an air piston cylinder device is used as the drive source 23; therefore, noise can be reduced to a  
20       minimum.

20       (Features of the Embodiment)

          [1] An automatic tube-type specimen container supply apparatus according to an embodiment, comprises:  
          a container storing box 10 a bottom of which has a tapered surface having a container collecting position  
25       14 in a lowest part thereof to collect a plurality of tube-type specimen containers 1 in one spot through an insertion port 10a;

a container individually-sending mechanism 20 configured to lift up the specimen containers 1, which are collected in the container collecting position 14, one by one along one side wall 15 located close to the container collecting position 14;

an outlet 31 formed in the one side wall 15 to discharge the specimen containers 1, which are lifted up by the container individually-sending mechanism 20, outside the container storing box 10; and

a container carry-out mechanism 30 including a carry-out conveyor 33 to automatically carry out the specimen containers 1 discharged through the outlet 31,

wherein the container individually-sending mechanism 20 includes a drive source 23 and a lifting plate 21 which is driven up and down by the drive source 23, and the lifting plate 21 has a top end with a tapered surface T1, the tapered surface T1 having a space to place only one specimen container lying on a side thereof and descending toward an outside of the container storing box 10.

In the automatic tube-type specimen container supply apparatus described above, whenever the lifting plate 21 ascends, only one specimen container 1 lying on its side on the top end of the plate 21 is discharged outside the box through the outlet 31. Consequently, the specimen containers 1 are automatically carried outside the box one by one and

thus supplied to a given position. Since, moreover,  
the specimen containers lifted up from below the box  
by the lifting plate 21 are removed from the outlet 31  
provided in the upper part of the box, there is no fear  
5 that the outlet 31 will be clogged.

[2] The automatic tube-type specimen container  
supply apparatus according to above item [1], further  
comprises an auxiliary plate 22 mounted on one side of  
the lifting plate 21 such that the auxiliary plate 22  
10 is slidable up and down relative to the lifting plate  
21, and the auxiliary plate 22 has a top end with  
a tapered surface T2 that descends toward an outside  
of the container storing box 10, the top end of the  
auxiliary plate 22 being flush with that of the lifting  
15 plate 22 when the lifting plate descends and being  
located in a lower level than that of the lifting plate  
21 when the lifting plate 21 ascends.

In the automatic tube-type specimen container  
supply apparatus described above, whenever the lifting  
20 plate 21 moves up and down, the wall of a block of  
specimen containers to be formed around the lifting  
plate 21 is crumbled by the function of the auxiliary  
plate 22. Thus, the specimen containers are always  
placed on the lifting plate 21 that has descended.  
25 The operation for sending out the specimen containers 1  
is performed without fail.

[3] In the automatic tube-type specimen container

supply apparatus according to one of above items [1]  
and [2], the container storing box 10 has a two-layer  
structure including a first partition plate 11 and a  
second partition plate 12 that are vertically opposed  
5 to each other, the first partition plate 11 having a  
tapered surface that descends from one side to another  
side, the second partition plate 12 having a tapered  
surface that descends in a direction opposite to the  
tapered surface of the first partition plate 11, and  
10 a path 13 is formed between the first and second  
partition plates 11 and 12 to allow one specimen  
container to pass therethrough.

In the automatic tube-type specimen container  
supply apparatus described above, the inserted specimen  
15 containers 1 are supplied to the container collecting  
position 14 with limitations in number and position.  
Therefore, the specimen containers 1 can be prevented  
from being collected simultaneously in the container  
collecting position 14 to an excessive degree, and the  
20 lifting plate 21 can smoothly be moved up and down.  
(Modification)

The automatic tube-type specimen container supply  
apparatus according to the embodiment of the present  
invention can be modified as follows.

25 A motor or a rotary solenoid can be used as the  
drive source 23.